Pursuant to Article 7, Paragraph 2 of the Law on Safety and Health at Work ("Official Gazette of RS", no. 101/05 and 91/15)

the Minister of Labor, Employment, Veteran and Social Affairs hereby issues the

RULEBOOK
on preventive measures for safety and health at work regarding the exposure to an electromagnetic field

Contents

Article 1

This Rulebook lays down the requirements that the employer is obliged to fulfill in order to ensure the application of preventive measures aimed at eliminating or reducing the risk of damage to the health of workers that arises or may arise due to exposure to an electromagnetic field in the workplace, exposure limit values and action levels.

Scope of application

Article 2

This Rulebook shall apply to workplaces where there is a risk to the safety and health of workers due to the known direct biophysical effects and indirect effects caused by electromagnetic field.

This Rulebook shall not apply to:

1) workplaces where workers can suffer from long-term effects from exposure to electromagnetic fields;

2) workplaces where workers are at risk due to direct contact with live wires.

Exposure limit values (ELV_s) encompass only values determined on the basis of a scientifically well established link of short-term direct biophysical effects and exposure to an electromagnetic field.

Definition of terms

Article 3

Certain terms used herein shall have the following meanings:

1) electromagnetic field is a static electric and static magnetic field and time varying electric, magnetic and electromagnetic field with a frequency of up to 300 GHz;

2) direct biophysical effects are effects on the human body directly caused by the presence in the electromagnetic field, which include:

(1) thermal effects, such as medical diathermy due to the absorption of energy from the electromagnetic field,

(2) non-thermal effects, such as stimulation of muscles, nerves and sensory organs. These effects can have harmful consequences on mental and physical health of workers exposed to the electromagnetic field, during which stimulation of sensory organs can lead to transient

symptoms, such as vertigo or phosphenes. These effects can create temporary annoyance or affect cognition or other brain or muscle functions and may thereby affect the ability of the worker to work in a safe and healthy way,

(3) limb currents;

3) indirect effects are effects caused by the presence of certain objects in the electromagnetic field, which can cause harmful effects on the health and safety of workers, such as:

(1) interference with medical electronic equipment and devices, including cardiac pacemakers and other implants or medical devices that are worn on the body,

(2) the projectile risk from ferromagnetic objects in a static magnetic field,

(3) the initiation of electro-explosive devices (detonators),

(4) fires and explosions resulting from the ignition of flammable materials by sparks caused by induced fields, contact currents or spark discharges,

(5) contact currents.

4) exposure limit values (ELV_s) mean values determined on the basis of biophysical and biological knowledge, particularly on the basis of scientifically well-established short-term and acute direct effects, i.e. thermal effects and electrical stimulation of tissue;

5) health effects exposure limit values mean those exposure limit values above which workers might be subject to adverse health effects, such as thermal heating or stimulation of nerve and muscle tissue;

6) sensory effects exposure limit values mean those exposure limit values above which workers might be subject to transient disturbed sensory perceptions and minor changes in brain functions;

7) action levels (AL_S) mean operational exposure levels established for the purpose of simplifying the process of demonstrating the compliance with relevant exposure limit values (ELVs) or, where appropriate, to take relevant measure for safe and healthy work and prevention measures specified in this Rulebook.

The term 'action levels' (AL_S) (Annex 2) of this Rulebook is used for:

1) electric fields of low-value and high-action action levels which relate to specific measures for safe and healthy work or prevention measures specified in this Rulebook;

2) magnetic fields of low action levels are levels that refer to sensory effects exposure limit values, and high action levels are levels that refer to the health effects exposure limit values.

Exposure limit values and action levels

Article 4

The physical quantities in terms of exposure to electromagnetic fields are given in Annex 1 of this Rulebook. The health effects exposure limit values, the sensory effects exposure limit values and action levels are given in Annex 2 and Annex 3 hereof.

The employer shall ensure that the exposure of workers to electromagnetic fields is not greater than the health effects exposure limit value and the sensory effects exposure limit value regarding non-thermal effects (Annex 2) and regarding thermal effects (Annex 3).

Adherence to the health effects exposure limit values and the sensory effects exposure limit values is provided on the basis of a risk assessment under Article 5 of this Rulebook.

When the exposure of a worker to an electromagnetic field exceeds the exposure limit values, the employer shall, without delay, take measures under Article 6, paragraph 9 of this Rulebook.

If it is determined during the process of risk assessment that exposure action levels from Annex 2 and Annex 3 of this Rulebook are not exceeded, then it is deemed that the employer respects the health effects exposure limit values and the sensory effects exposure limit values.

When a worker during work is exposed to values that exceed the action levels, then the employer shall act in accordance with Article 6, paragraph 2 of this Rulebook, unless it is determined that relevant exposure limit values are not exceeded and that risks to safety and health may be excluded on the basis of an assessment carried out in accordance with Article 5 paragraph 1, 4 and 5 of this Rulebook.

Notwithstanding paragraph 5 and 6 of this Article, exposure may be exceeded by:

1) low action levels for electric fields (Annex 2, Table B1), where justified by practice or process, provided either that the sensory effects exposure limit values (Annex 2, Table A3) are not exceeded, or:

(1) the health effects exposure limit values are not exceeded (Annex 2, Table A2)

(2) the excessive spark discharges and contact currents (Annex 2, Table B3) are prevented by application of specific measures for safety and health at work laid down in Article 6, paragraph 8 of this Rulebook and

(3) information on the situations referred to in Article 7, item 5) of this Rulebook has been given to workers;

2) low action levels for magnetic fields (Annex 2, Table B2) where justified by practice or process, including the head and the torso, during the shift, provided that the sensory effects exposure limit values are not exceeded (Annex 2, Table A3) or:

(4) exposure limit values are exceeded only temporarily,

(5) the health effects exposure limit values (Annex 2, Table A2) are not exceeded,

(6) measures were taken in accordance with Article 6 paragraph 14 of this Rulebook, when there are transient symptoms referred to in Article 6, paragraph 15, item 1) of this Rulebook and

(7) information on the situations referred to in Article 7, item 6) of this Rulebook has been given to workers.

Notwithstanding paragraphs 2 to 7 of this Article, exposure may be exceeded by:

1) the sensory effects exposure limit values (Annex 2, Table A1) during the shift, if justified by practice or process, provided that:

(1) they are exceeded only temporarily,

(2) the health effects exposure limit values (Annex 2, Table A1) are not exceeded,

(3) special protection measures have been taken for safety and health at work in accordance with Article 6, paragraph 9 of this Rulebook,

(4) measures have been taken in accordance with Article 6, paragraph 14 of this Rulebook, if there are short-term symptoms from Article 6, paragraph 15, item 2) of this Rulebook and

(5) the workers are informed about the situations referred to in Article 7, item 6) of this Rulebook;

2) exposure limit values accompanied by sensory effects (Annex 2, Table A3) and (Annex 3, Table A2) during the shift, if justified by practice or process, provided that:

(1) they are exceeded only temporarily,

(2) the health effects exposure limit values (Annex 2, Table A2) and (Annex 3, Table A1 and Table A3) are not exceeded,

(3) measures are taken in accordance with Article 6, paragraph 14 of this Rulebook, if there are short-term symptoms in Article 6, paragraph 15, item 1) hereo,

(4) the workers are informed about the situations referred to in Article 7, item 6) of this Rulebook.

The physical quantities regarding the exposure to electromagnetic fields (Annex 1), non-thermal effects of exposure limit values and action levels in the frequency range from 0 Hz to 10 MHz (Annex 2) and thermal effects of exposure limit values and action levels in the frequency range from 100 kHz to 300 GHz (Annex 3) are printed together with this Rulebook and form an integral part thereof.

Obligations of the employer

Article 5

The employer shall assess the risk of damage to the health of workers for all workplaces in a working environment where there is a possibility of exposure of workers to electromagnetic fields and, if necessary, to ensure that the value of the electromagnetic field to which workers are exposed is measured and calculated.

An employer may publish the results of the risk assessment, in accordance with the law, without stating personal data for workers who are exposed to the electromagnetic field.

In the process of the risk assessment referred to in paragraph 1 of this Article, the employer shall identify and assess the electromagnetic fields in the workplace, taking into account relevant practical guidelines of the European Commission and other relevant recommendations and guidelines, including exposure databases.

The employer shall, where relevant, take into account the values of emissions or other appropriate safety-related data provided by the equipment manufacturer or his representative, and which relate to safety and health at work with the equipment, including risk assessment for exposure conditions to electromagnetic field at the workplace or place of equipment installation, if necessary.

If compliance with the exposure limit values cannot be reliably determined on the basis of readily accessible information, then risk assessment is carried out based on measurements or calculations. In this case, derogations in terms of measurements or calculations, such as numerical errors, source modeling, phantom geometry and the electrical properties of tissues and materials, determined in accordance with the appropriate good practice are taken into account in the process of risk assessment.

The assessment, measurement and calculations referred to in paragraphs 1 to 5 of this Article shall be planned and carried out by the competent person of the employer and a legal entity licensed for performing testing in the working environment within the established deadlines, taking into account the consultation with workers.

The exposure data obtained by assessment, measurement or calculation are stored in an appropriate form, to allow their subsequent use in accordance with regulations in the field of safety and health at work.

During the risk assessment, the employer shall give particular attention to the following:

1) the heath effects exposure limit values, the sensory effects exposure limit values and action levels referred to in Article 4 (Annex 2) and (Annex 3) of this Rulebook;

2) the frequency, the level, duration and type of exposure, including the distribution over the worker's body and over the area of the workplace;

3) any direct biophysical effects;

4) any effects on the health and safety of workers at particular risk, in particular workers who wear active or passive implanted medical devices (such as cardiac pacemakers), workers with medical devices worn on the body (such as insulin pumps) and pregnant women;

5) any indirect effects;

6) the existence of alternative equipment designed to reduce the level of exposure to electromagnetic fields;

7) appropriate information obtained from the health surveillance of the workers referred to in Article 9 of this Rulebook;

8) information provided by the manufacturer of equipment;

9) other relevant information related to safety and health at work;

10) multiple sources of exposure;

11) simultaneous exposure to multiple frequency fields.

The employer is not obliged to assess the risk of exposure to electromagnetic fields in workplaces where the estimation is made in terms of population exposure to electromagnetic fields in accordance with the regulations on environmental protection and when only the equipment intended for public use is used in accordance with the purpose and all the safety-related and technical data.

The employer shall possess a Risk Assessment Act to determine measures for eliminating and reducing the risk of damage to the health of workers, which are applied in accordance with Article 6 of this Rulebook.

The risk assessment may contain an explanation of the employer, according to which, due to the nature and level of risks from exposure to electromagnetic fields, no further detailed risk assessment is necessary.

The employer shall make partial modification and/or amendment of the Risk Assessment Act in the case of every new danger or harm, and changes in the level of risk in the work process or when the results of the health surveillance of the worker show that this is necessary.

Preventive measures

Article 6

The employer shall, starting from the principle of prevention and taking into account modern technical solutions and the availability of measures of risk control at source, ensure the implementation of preventive measures, so that the risk arising from exposure to electromagnetic fields is eliminated or reduced to a minimum.

Based on the risk assessment process conducted under Article 5 of this Rulebook, when the action levels referred to in Article 4 (Annex 2) and (Annex 3) of this Rulebook are exceeded, unless the assessment carried out in accordance with Article 4 paragraph 1, 2 and 3 of this Rulebook proves that specific exposure limit values are not exceeded and that the risks can be excluded, the employer shall prepare and implement an action plan comprising technical and/or

organizational measures in order to prevent exposure above the health effects exposure limit values and sensory effects exposure limit values, particularly taking into account the following:

1) other methods which will ensure the reduction of exposure to the electromagnetic field;

2) the choice of appropriate work equipment emitting less intense electromagnetic field, taking into account the work to be performed;

3) technical measures taken to reduce the emissions of electromagnetic fields, including when necessary, the use of protective blocking devices, armored or similar mechanisms for health protection;

4) appropriate delimitation and access measures, such as signals, labels, floor markings, barriers, in order to limit or control access;

5) measures and procedures to control spark discharge and contact currents using technical means and the training of workers for safety and health at work;

6) appropriate maintenance programs for work equipment, workplaces and places where workers perform their tasks;

7) the design and layout of workplaces;

8) limitation of the duration and intensity of exposure;

9) the availability of adequate means and equipment for personal protection at work.

On the basis of the risk assessment under Article 5 of this Rulebook, the employer shall devise and implement an action plan that includes technical and/or organizational measures to prevent any risk to workers who are at particular risk and any risks caused by indirect effects of Article 5 of this Rulebook.

The employer shall adapt the measures referred to in this Article to the requirements of the workers who are exposed to special risk and provide them with special protection, which refers specifically to workers who were reported to use active or passive implanted medical devices (such as cardiac pacemakers) or medical equipment which is worn on the body (such as insulin pumps) and pregnant women who have informed the employer about their condition.

When it is established that exposure of workers to an electromagnetic field can be higher than the action levels from Article 4 of this Rulebook (Annex 2 and Annex 3) on the basis of the risk assessment under Article 5 of this Rulebook, the employer shall indicate the workplaces in the area with appropriate signs in accordance with the regulations on safety and health at work.

The employer shall, when there is a risk of exceeding the action levels, identify the area and, when necessary, restrict access to this area.

When access to these areas is restricted for other reasons, and the workers are informed about the risks from exposure to an electromagnetic field, the employer is not obliged to indicate that area with the appropriate signs and restrict access.

When the low action lelevs for electric fields referred to in Article 4, paragraph 7, item 1), subitem (1), (2) and (3) of this Rulebook are exceeded, the employer shall take specific protection measures such as training of workers in accordance with Article 7 of this Rulebook and the use of technical means such as the grounding of means of work, the bonding of workers with means of work (equipotential bonding) and the use of appropriate means for personal protection at work.

When the sensory effect exposure limit values from Article 4, paragraph 8, item 1) of this Rulebook are exceeded, the employer shall apply specific measures such as controlling movements.

The employer shall ensure that workers are not exposed to the electromagnetic field above the health effects exposure limit values and the sensory effects exposure limit values unless the conditions under Article 10, item 1) or 2) or Article 4, paragraph 7 and 8 of this Rulebook are fulfilled.

If, despite the measures taken by the employer, the health effects exposure limit values and the sensory effects exposure limit values are exceeded, the employer shall immediately take steps to ensure that the exposure to the electromagnetic field is below the exposure limit values.

If the exposure is greater than the health effects exposure limit values and the sensory effects exposure limit values, the employer shall determine the reasons for exceeding the exposure limit values and adapt preventive measures appropriately for safety and health at work as to prevent the exceeding of limit values again.

The employer shall preserve the data relating to the measures referred to in paragraph 12 of this Article in a suitable traceable form so as to permit their use at a later stage.

In accordance with Article 4, paragraph 7 and 8 of this Rulebook, when the workers report transient symptoms, the employer shall amend the Risk Assessment Act and the prevention measures, if necessary.

Transient symptoms include:

1) sensory perceptions and effects in the functioning of the central nervous system in the head evoked by time varying magnetic field and

2) static magnetic field effects, such as vertigo and nausea.

Worker information and training

Article 7

The employer shall ensure that workers who are or are likely to be exposed to risks from electromagnetic fields at work and/or their representatives for safety and health at work receive any necessary information on measures which are taken with the aim of realizing safe and healthy conditions of work and to ensure that these workers receive the information on types of risks during exposure to an electromagnetic field during training for safety and health at work and the outcomes of the risk assessment referred to in Article 5 of this Rulebook, in particular about:

1) the measures taken in accordance with this Rulebook to eliminate or reduce risks from electromagnetic fields;

2) the values and importance of the exposure limit values and action levels, the associated possible risks and the preventive measures taken;

3) the possible indirect effects of exposure;

4) the results of the risk assessment, measurement or calculations of the levels of exposure to electromagnetic fields, in accordance with Article 5 of this Rulebook;

5) ways of detecting and reporting adverse health effects of exposure on the health;

6) the possibility of appearance of transient symptoms and sensations related to effects on the central or peripheral nervous system;

7) the circumstances in which workers are entitled to health surveillance;

8) safe working practices to minimize risks resulting from exposure to the electromagnetic field;

9) workers at particular risk, as referred to in Article 5, paragraph 8, item 4) and Article 6, paragraph 3 and 4 of this Rulebook.

Cooperation of the employer and the workers

Article 8

The employer and the worker and/or their representatives for safety and health at work shall cooperate in all matters related to exposure to an electromagnetic field and the application of preventive measures.

Health surveillance

Article 9

The employer is required to provide prescribed health surveillance for workers who work in workplaces that are assessed as workplaces with a higher risk of possible health damage due to electromagnetic field exposure, based on the results of a risk assessment under Article 5 of this Rulebook.

The employer shall ensure a targeted medical examinations if any undesired or unexpected health effect is reported by a worker, or in any event where exposure above the exposure limit values is detected.

The targeted medical examination referred to in paragraph 2 of this Article shall be done in the manner, according to the procedure and within the timeframe as the previous and periodical medical examination of workers at the workplace with increased risk.

The employer shall provide access to the results of the risk assessment from Article 5 of this Rulebook to occupational health services which monitor the health status of workers.

The examinations from paragraph 2 and 3 of this Article shall be made available during hours chosen by the worker, and any costs arising from the examinations shall be borne by the employer.

The results of health surveillance shall be preserved in a suitable form that allows them to be consulted at a later date, subject to compliance with confidentiality requirements for keeping personal data.

Individual workers shall, at their request, have access to their own personal health records.

The health records shall be kept and preserved in accordance with the regulations on health documentation and records in the field of medicine.

Derogations

Article 10

By way of derogation from Article 4 but without prejudice to Article 6, item 1 of this Rulebook, the following shall apply:

1) exposure may exceed the exposure limit values if the exposure is related to the installation, use, development or research related to magnetic resonance imaging (MRI) equipment for patients in the health sector, provided that the following conditions are met:

(1) during the risk assessment carried out in accordance with Article 5 hereof, it has been determined that the exposure limit values are exceeded;

(2) taking into account the development of technology, all technical and/or organizational measures have been applied;

(3) the circumstances duly justify exceeding the exposure limit values;

(4) the characteristics of the workplace, work equipment, or work process have been taken into account;

(5) the employer has provided the workers with the instructions for use, delivered by the equipment manufacturer, with a view to protecting the workers against adverse health effects on the safety and health of the workers.

2) in duly justified circumstances and only for as long as they remain duly justified, when it is allowed for the exposure limit values to be temporarily exceeded in specific sectors or for specific activities outside the scope of item 1) of this Article. 'Duly justified circumstances' shall mean circumstances in which the following conditions are met:

(1) the risk assessment carried out in accordance with Article 5 of this Rulebook has shown that the exposure limit values are exceeded,

(2) taking into account the development of technology, all technical and/or organizational measures have been applied,

(3) the specific characteristics of the workplace, work equipment, or work process have been taken into account;

(4) the employer has provided the workers with the instructions for use, delivered by the equipment manufacturer, with a view to protecting the workers against adverse health effects on the safety and health of the workers.

Transitional and final provisions

Article 11

On the date of entry into force of this Rulebook, the Rulebook on preventive measures for safety and health at work regarding the exposure to an electromagnetic field ("Official Gazette of RS", no. 117/12) cease to be valid.

Entry into force

Article 12

This Rulebook shall enter into force on the eighth day of its publication in the "Official Gazette of the Republic of Serbia", and shall apply from 1 July 2018.

No. 110-00-00006/2015-01
In Belgrade, 21 December, 2015

MINISTER

Aleksandar Vulin

Annex

1.

PHYSICAL QUANTITIES REGARDING THE EXPOSURE TO ELECTROMAGNETIC FIELDS

The following physical quantities are used to describe the exposure to electromagnetic fields:

1) electric field strength (E), a vector quantity that corresponds to the force exerted on a charged particle regardless of its motion in space. It is expressed in Vm^{-1}. A distinction has to be made between the environmental electric field and the electric field present in the body as a result of exposure to the environmental electric field.

2) limb current (I_L) , a current in the limbs of a person exposed to electromagnetic fields in the frequency range from 10 MHz to 110 MHz as a result of contact with an object in an electromagnetic field or the flow of capacitive currents induced in the exposed body. It is expressed in A.

3) contact current (I_C), a current that appears when a person comes into contact with an object in an electromagnetic field. It is expressed in A. A steady state contact current occurs when a person is in continuous contact with an object in an electromagnetic field. In the process of making such contact, a spark discharge may occur with associated transient currents.

4) electric charge (Q), an appropriate quantity used for spark discharge and is expressed in C.

5) magnetic field strength (H), a vector quantity that, together with the magnetic flux density, specifies a magnetic field at any point in space. It is expressed in Am^{-1}.

6) magnetic induction (magnetic flux density) (B), a vector quantity, describing the magnetic field, resulting in a force that acts on moving charges, expressed in T. In free space and in biological materials, magnetic flux density corresponds to the magnetic field strength 1 Am^{-1}. In the free space between the magnetic induction in T and magnetic field strength in Am^{-1}, relation $B = 4\pi\ 10^{-7}$ T (which is approximately 1.25 μ) holds true.

7) Power density (S) is an appropriate quantity used for very high frequencies, where the depth of penetration in the human body is low. It is the radiant power incident perpendicular to a surface. It is expressed in Wm^{-2}.

8) Specific energy absorption (SA) is energy absorbed per unit mass of biological tissue, expressed in Jkg^{-1}. In this Rulebook, it is used for establishing limits for effects from pulsed microwave radiation.

9) Specific energy absorption rate (SAR), averaged over the whole body or over parts of the body, is the rate at which energy is absorbed per unit mass of body tissue and is expressed in Wkg^{-1}. Whole-body SAR is a widely accepted quantity for relating adverse thermal effects to radio frequency (RF) exposure. Besides the whole-body average SAR, local SAR values are necessary to evaluate and limit excessive energy deposition in small parts of the body resulting from special exposure conditions. Examples of such conditions include: an individual exposed to RF in the low MHz range (e.g. from dielectric heaters) and individuals exposed in the near field of an antenna.

Of these quantities, magnetic flux density (B), contact current (I_C), limb current (I_L), electric field strength (E), magnetic field strength (H), and power density (S) can be measured directly.

ANNEX 2.

NON-THERMAL EFFECTS OF EXPOSURE LIMIT VALUES AND ACTION LEVELS IN THE FREQUENCY RANGE FROM 0 Hz TO 10 MHz

EXPOSURE LIMIT VALUES (ELVs)

Exposure limit values below 1 Hz (Table A1) are limits for static magnetic field which is not affected by the tissue of the body.

Exposure limit values for frequencies from 1 Hz to 10 MHz (Table A2) are limits for electric fields induced in the body from exposure to time-varying electric and magnetic fields.

Exposure limit values for external magnetic induction
(magnetic flux density) from 0 to 1 Hz

The sensory effects exposure limit values are the exposure limit values for normal working conditions (Table A1) and they are related to vertigo and other physiological effects related to disturbance of the human balance organ resulting from moving in a static magnetic field. (Table A1)

The health effects exposure limit values are exposure limit values for controlled working conditions (Table A1) which are applicable on a temporary basis during the shift when justified by the practice or process, provided that preventive measures, such as controlling movements and providing information to workers, have been adopted.

Table A1

Exposure limit values for external magnetic flux density (B_0) from 0 to 1 Hz

	Sensory effects exposure limit values
Normal working conditions	2 T
Localised limbs exposure	8 T
	Health effects exposure limit values
Controlled working conditions	8 T

Health effects exposure limit values
for internal electric field strength from 1 Hz to 10 MHz

Health effects exposure limit values (Table A2) are related to electric stimulation of all peripheral and central nervous system tissues in the body, including the head.

Table A2

Health effects exposure limit values for internal electric field strength from 1 Hz to 10 MHz

Frequency range	Health effects exposure limit values
$1\ \text{Hz} \leq f < 3\ \text{kHz}$	$1{,}1\ \text{Vm}^{-1}$ (peak)
$3\ \text{kHz} \leq f \leq 10\ \text{MHz}$	$3{,}8 \times 10^{-4}\ f\ \text{-Vm}^{-1}$ (peak)

Notes:

1) f is the frequency expressed Hz.
2) the health effects ELVs for internal electric field are spatial peak values in the entire body of the exposed subject.
3) the exposure limit values are peak values in time which are equal to the Root-Mean-Square (RMS) values multiplied by √2 for sinusoidal fields. In the case of non-sinusoidal fields, exposure evaluation carried out in accordance with Article 5 of this Regulation shall be based on the weighted peak method (filtering in time domain), explained in the practical guidelines of the European Commission but other scientifically proven and validated exposure evaluation procedures can also be applied, provided that they lead to approximately equivalent and comparable results.

Sensory effects exposure limit values
for internal electric field strength from 1 Hz to 400 Hz

The sensory effects exposure limit values (Table A3) are related to electric field effects on the central nervous system in the head, i.e. retinal phosphenes and minor transient changes in some brain functions.

Table A3

Sensory effects exposure limit values
for internal electric field strength from 1 to 400 Hz

Frequency range	Sensory effects exposure limit values
$1 \leq f < 10$ Hz	$0{,}7/f$ Vm^{-1} (peak)
$10 \leq f < 25$ Hz	$0{,}07$ Vm^{-1} (peak)
$25 \leq f \leq 400$ Hz	$0{,}0028\ f$ Vm^{-1} (peak)

Notes:

1) f is the frequency expressed in Hz;
2) The sensory effects ELVs for internal electric field are spatial peak values in the head of the exposed subject;
3) The ELVs are peak values in time which are equal to the Root-Mean-Square (RMS) values multiplied by √2 for sinusoidal fields. In the case of non-sinusoidal fields, the exposure

evaluation carried out in accordance with Article 5 of this Regulation shall be based on the weighted peak method (filtering in time domain) explained in the practical gudielines of the European Commission, but other scientifically proven and validated exposure evaluation procedures can also be applied, provided that they lead to approximately equivalent and comparable results.

ACTION LEVELS (ALs)

The following physical quantities and values are used to specify the action levels (ALs), the magnitude of which are established to ensure by simplified assessment the compliance with relevant ELVs or at which relevant protection or prevention measures specified in Article 6 of this Rulebook must be taken:

1) Low action levels ALs(E) and high action levels ALs(E) for electric field strength (E) of time varying electric fields (Table B1);
2) Low action levels ALs(E) and high action levels ALs(E) for magnetic flux density (B) of time varying magnetic fields (Table B2);
3) action levels (Ic) for contact current (Table B3);
4) ALs(B_0) for magnetic induction (magnetic flux density) of static magnetic fields (Table B4).

Action levels correspond to calculated or measured electric and magnetic field values at the workplace in the absence of the worker.

Action levels (ALs) for exposure to electric fields

Low action levels (Table B1) for external electric field are based on limiting the internal electric field below the exposure limit values (Table A2) and (Table A3) and limiting spark discharges in the working environment.

Below high ALs, the internal electric field does not exceed the ELVs (Table A2) and (Table A3) and annoying spark discharges are prevented, provided that the protection measures referred to in Article 6 paragraph 8 of this Rulebook are taken.

Table B1

Action levels for exposure to electric fields from 1 Hz to 10 MHz

Frequency range	Electric field strength (E)[Vm^{-1}] (RMS) low action levels (ALs(E))	Electric field strength (E) [Vm^{-1}] (RMS) high action levels (ALs(E))
$1 \leq f < 25$ Hz	$2{,}0 \times 10^4$	$2{,}0 \times 10^4$
$25 \leq f < 50$ Hz	$5{,}0 \times 10^5/f$	$2{,}0 \times 10^4$
50 Hz $\leq f <$ 1,64 kHz	$5{,}0 \times 10^5/f$	$1{,}0 \times 10^6/f$
$1{,}64 \leq f < 3$ kHz	$5{,}0 \times 10^5/f$	$6{,}1 \times 10^2$

3 kHz ≤ f ≤ 10 MHz	$1,7 \times 10^2$	$6,1 \times 10^2$

Notes:

1) f is the frequency expressed in Hz.

2) The low action levels (E) and high action levels (E) are the Root-Mean-Square values of the electric field strength which are equal to the peak values divided by √2 for sinusoidal fields. In the case of non-sinusoidal fields, the exposure evaluation carried out in accordance with Article 5 of this Rulebook shall be based on the weighted peak method (filtering in time domain), explained in the practical guidelines of the European Commission, but other scientifically proven and validated exposure evaluation procedures can also be applied, provided that they lead to approximately equivalent and comparable results.

3) action levels represent maximum calculated or measured values at the workers' body position. This results in a conservative exposure assessment and automatic compliance with ELVs in all non-uniform exposure conditions. In order to simplify the assessment of compliance with ELVs, carried out in accordance with Article 5 of this Rulebook, in specific non-uniform conditions, criteria for the spatial averaging of measured fields based on established dosimetry will be laid down in the practical guidelines of the European Commission. In the case of a very localized source within a distance of a few centimeters from the body, the induced electric field shall be determined dosimetrically, case by case.

Action levels (ALs) for exposure to magnetic fields

Low action levels (Table B2) are, for frequencies below 400 Hz, derived from the sensory effects exposure limit values (Table A3) and, for frequencies above 400 Hz, from the health effects exposure limit values for internal electric fields (Table A2).

High action levels (Table B2) are derived from the sensory effects exposure limit values for internal electric field related to electric stimulation of peripheral and autonomous nerve tissues in head and trunk (Table A2). Compliance with the high action levels ensures that health effects exposure limit values are not exceeded, but that effects related to retinal phosphenes and minor transient changes in brain activity are possible, if the exposure of the head exceeds the low action levels for exposures up to 400 Hz. In such a case, Article 6, paragraph 8 of this Rulebook shall apply.

ALs for exposure of limbs are derived from the health effects ELVs for internal electric field related to electric stimulation of the tissues in limbs by taking into account that the magnetic field is coupled more weakly to the limbs than to the whole body.

Table B2

Action levels for exposure to magnetic fields from 1 Hz to 10 MHz

Frequency range	Magnetic flux density (B)[μT] (RMS) low action levels	Magnetic flux density (B) [μT] (RMS) high action levels	Magnetic flux density action levels for exposure of limbs to a localized magnetic field [μT]

			(RMS)
$1 \leq f < 8$ Hz	$2{,}0 \times 10^5/f^2$	$3{,}0 \times 10^5/f$	$9{,}0 \times 10^5/f$
$8 \leq f <$ 25 Hz	$2{,}5 \times 10^4/f$	$3{,}0 \times 10^5/f$	$9{,}0 \times 10^5/f$
$25 \leq f <$ 300 Hz	$1{,}0 \times 10^3$	$3{,}0 \times 10^5/f$	$9{,}0 \times 10^5/f$
300 Hz $\leq f <$ 3 kHz	$3{,}0 \times 10^5/f$	$3{,}0 \times 10^5/f$	$9{,}0 \times 10^5/f$
3 kHz $\leq f \leq$ 10 MHz	$1{,}0 \times 10^2$	$1{,}0 \times 10^2$	$3{,}0 \times 10^2$

Notes:

1) f is the frequency expressed in Hz.

2) the low action levels (E) and the high action levels are the Root-Mean-Square values which are equal to the peak values divided by $\sqrt{2}$ for sinusoidal fields. In the case of non-sinusoidal fields the exposure evaluation carried out in accordance with Article 5 of this Rulebook shall be based on the weighted peak method (filtering in time domain), explained in practical guidelines of the European Commission, but other scientifically proven and validated exposure evaluation procedures can also be applied, provided that they lead to approximately equivalent and comparable results;

3) action levels for exposure to magnetic fields represent maximum values at the workers' body position. This results in a conservative exposure assessment and automatic compliance with exposure limit values in all non-uniform exposure conditions. In order to simplify the assessment of compliance with exposure limit values, carried out in accordance with Article 5 of this Rulebook, in specific non-uniform conditions, criteria for the spatial averaging of measured fields based on established dosimetry will be laid down in the practical guidelines of the European Commission. In the case of a very localized source within a distance of a few centimeters from the body, the induced electric field shall be determined dosimetrically, from case to case.

Table B3

Action levels for contact current (Ic)

Frequency	Action levels for steady state contact current (I_C) [mA] (RMS)
up to 2,5 kHz	1,0
$2{,}5 \leq f < 100$ kHz	0,4 f
$100 \leq f \leq 10\,000$ kHz	40

Note:

f is the frequency expressed in kHz.

Action levels (ALs) for magnetic flux density of static magnetic fields

Table B4

ALs for magnetic flux density of static magnetic fields

Hazards	Action levels (B_0)
Interference with active implanted devices (cardiac pacemakers)	0,5 mT
Attraction and projectile risk in the fringe field of high field strength sources (> 100 mT)	3 mT

Annex 3.

THERMAL EFFECTS OF
EXPOSURE LIMIT VALUES AND ACTION LEVELS
IN THE FREQUENCY RANGE FROM 100 kHz TO 300 GHz

Exposure limit values (ELVs)

Health effects exposure limit valuess for frequencies from 100 kHz to 6 GHz (Table A1) are limits for energy and power absorbed per unit mass of body tissue generated from exposure to electric and magnetic fields.

Sensory effects exposure limit values for frequencies from 0,3 to 6 GHz (Table A2) are limits on absorbed energy in a small mass of tissue in the head from exposure to electromagnetic fields.

Health effects exposure limit values for frequencies above 6 GHz (Table A3) are limits for power density of an electromagnetic wave incident on the body surface.

Table A1

Health effects exposure limit values
for exposure to electromagnetic fields from 100 kHz to 6 GHz

Health effects exposure limit values	Specific absorption rate values (SAR) averaged over a six-minute period
Exposure limit values related to whole body heat stress expressed as averaged (SAR) in the body	0,4 Wkg^{-1}
Exposure limit values related to localized heat stress in head and trunk expressed as localized (SAR) in the body	10 Wkg^{-1}

Exposure limit values related to localized heat stress in the limbs expressed as localized (SAR) in the limbs	20 Wkg^{-1}

Note:

Localized SAR averaging mass is calculated on any 10 g of contiguous tissue, and the maximum SAR obtained in such a way should be the value used for estimating exposure. This 10 g of tissue is intended to be a mass of contiguous tissue with roughly homogeneous electrical properties. In specifying a contiguous mass of tissue, it is recognized that this concept may be used in computational dosimetry but may present difficulties for direct physical measurements. Geometrical validity can also be used, such as cubic or spheric tissue mass.

Sensory effects exposure limit values from 0,3 GHz to 6 GHz

The sensory effects exposure limit values (Table A2) are related to avoiding auditory effects caused by exposure of the head to pulsed microwave radiation.

Table A2

Sensory effects exposure limit values for exposure to electromagnetic fields from 0,3 to 6 GHz

Frequency range	Localised specific energy absorption (SA)
$0,3 \leq f \leq 6$ GHz	10 $mJkg^{-1}$

Note:

Localised specific energy absorption averaging mass is 10 g of tissue.

Table A3

Health effects exposure limit values for exposure to electromagnetic fields from 6 to 300 GHz

Frequency range	Health effects exposure limit values related to power density
$6 \leq f \leq 300$ GHz	50 Wm^{-2}

Note:

The power density shall be averaged over any 20 cm^2 of exposed area. Spatial maximum power densities averaged over 1 cm^2 should not exceed 20 times the value of 50 Wm^{-2}. Power density from 6 to 10 GHz is to be averaged over any six-minute period. Above 10 GHz, the power density shall be averaged over any $68/f^{1,05}$-minute period (f is the frequency in GHz) to compensate for progressively shorter penetration depth, as the frequency increases.

ACTION LEVELS (ALs)

The following physical quantities and values are used to specify the action levels (AL_s), whose quantity is established to ensure the compliance with the relevant exposure limit values or

relevant protection or prevention measures specified in Article 6 of this Rulebook, which must be taken:

1) action levels (AL_s (E)) for electric field strength E of time varying electric field (Table B1);
2) action levels (AL_s (B)) for magnetic flux density B of time varying magnetic field (Table B1);
3) action levels (AL_s (S)) for power density S of electromagnetic waves (Table B1);
4) action levels (AL (I_c)) for contact current (Table B2);
5) action levels (AL(I_L)) for limb current (Table B2).

Action levels correspond to calculated or measured field values at the workplace in the absence of the worker, as maximum value considering the position of the body or specified part of the body.

Action levels (ALs) for exposure to electric and magnetic fields

Action levels (ALs(E)) and (ALs(B)) are derived from the SAR or power density exposure limit values (Table A1 and Table A3) based on the limit values related to internal thermal effects caused by exposure to (external) electric and magnetic fields.

Table B1

Action levels for electric fields from 100 kHz to 300 GHz

Frequency range	Action level (ALs(E)) for electric field strength [Vm^{-1}] (RMS)	Action level (ALs(B)) for magnetic flux density [μT] (RMS)	Action level (ALs(S)) for power density [Vm^{-1}] (RMS)
100 kHz ≤ f < 1 MHz	$6{,}1 \times 10^2$	$2{,}0 \times 10^6/f$	—
1≤ f < 10 MHz	$6{,}1 \times 10^8/f$	$2{,}0 \times 10^6/f$	—
10 ≤ f < 400 MHz	61	0,2	—
400 MHz ≤ f < 2 GHz	$3 \times 10^{-3}\ f^{½}$	$1{,}0 \times 10^{-5}\ f^{½}$	—
2 ≤ f < 6 GHz	$1{,}4 \times 10^2$	$4{,}5 \times 10^{-1}$	—
6 ≤ f ≤ 300 GHz	$1{,}4 \times 10^2$	$4{,}5 \times 10^{-1}$	50

Notes:

1) f is the frequency expressed in Hz.

2) levels for $[ALs(E)]^2$ and $[ALs(B)]^2$ are to be averaged over a six-minute period. For RF pulses, the peak power density averaged over the pulse width shall not exceed 1 000 times the respective action level value (ALs(S)). For multi-frequency fields, the analysis shall be based on summation, as explained in the practical guidelines of the European Commission.

3) action levels ALs(E) and ALs(B) represent maximum calculated or measured values at the workers' body position. This results in a conservative exposure assessment and automatic compliance with ELVs in all non-uniform exposure conditions. In order to simplify the

assessment of compliance with ELVs, carried out in accordance with Article 5 of this Rulebook, in specific non-uniform conditions, criteria for the spatial averaging of measured fields based on established dosimetry will be laid down in the practical guidelines of the European Commission. In the case of a very localized source within a distance of a few centimeters from the body, compliance with ELVs shall be determined dosimetrically, from case to case;

4) the power density shall be averaged over any 20 cm^2 of exposed area. Spatial maximum power densities averaged over 1 cm^2 should not exceed 20 times the value of 50 Wm^{-2}. Power densities from 6 to 10 GHz are to be averaged over any six-minute period. Above 10 GHz, the power density shall be averaged over any $68/f^{1,05}$-minute period (f is the frequency in GHz) to compensate for progressively shorter penetration depth as the frequency increases.

Table B2

ALs for steady state contact currents and induced limb currents

Frequency range	Steady state contact currents action levels ALs(I_C) [mA] (RMS)	Induced limb current in any limb action levels, ALs(I_L) [mA] (RMS)
100 kHz ≤ f < 10 MHz	40	—
10 ≤ f ≤ 110 MHz	40	100

Note:

$[ALs(I_L)]^2$ average action level for induced limb current is to be averaged over a six-minute period.